the preliminary notice it appears that his apparatus has given an important addition to our knowledge of the solar radiation and of the atmospheric absorption at that place. This portable compensation pyrheliometer, with rheostat, small galvanometer, electro-dynamometer, and Leclanche cell, packed in a box 16 inches high, 10 inches wide, and 5 inches deep, weighs, with its tripod, 15 pounds, and is so arranged that it can be set up for use in a very few minutes. Angström's apparatus is equally applicable to the measurement of the radiation from very feeble sources of heat, such as a lamp or a warm block of stone or metal, and is peculiarly valuable as a means of determining the constants of the bolometer or thermopile.

THE USE OF THE DIVINING ROD IN THE SEARCH FOR WATER.

According to the Scientific American for April 7, 1900, a commission has been appointed in France to study all apparatus and methods employed by sorcerers, water seers, and wizards, who use the divining rod, mineral rod, exploring pendulums, hydroscopic compasses, and the other instruments which go by a host of other fanciful names. The French engineer, M. Borthier de Rollière, is the president of the commission. He will procure divining rods of all kinds, including books, reviews, journals, reports of experiments, together with the names and addresses of the inventors of the alleged devices. All the facts and documents may be sent to M. de Rollière, care of Cosmos, 8 Rue François Premier, Paris, France. It is to be hoped that the findings of this commission will, once for all, settle the question of the divining rod, not only for the discovery of water, but also minerals. In England, particularly, the water diviner plies his lucrative profession without legal interference, and strange to say, his dupes are often town authorities. The whole business is akin to that of the fortune teller, the spiritualist, or any other charlatan, and it is strange that the exponents of such systems are allowed to pursue their avocations undisturbed by fear of prosecution. At present the victims are the only ones punished.

TIDES IN THE OCEAN AND THE ATMOSPHERE.

The Editor has from time to time received requests for a satisfactory popular explanation of the manner in which the attractions of the sun and moon produce tides in the ocean, and why it is that similar gravitational tides in the earth's atmosphere are not observed. Such an explanation has been in manuscript for several years, undergoing the emendations of critics who are familiar with the subject, and will, we hope, when published, satisfy the desires of our correspondents.

Of late years special attention has been given by eminent meteorologists and physicists to the proper explanation of the periodic variations in atmospheric or barometric pressure, known as the diurnal, simidiurnal, and terdiurnal periods. It seems to be agreed that these do not owe their origin to any action of solar or lunar gravitation, but that they may be the result of solar heat which expands the lower atmosphere and maintains a so-called diurnal wave of temperature in the atmosphere which gives rise to a wave of elastic pressure. Such a pressure wave would run around the earth in twelve hours, if the average temperature of the air were —5° C., whereas the temperature wave goes round once in twenty-four hours. Therefore, a stationary free pressure wave would be maintained by the forced temperature wave and produce both diurnal and semidurnal barometric oscillations. If the temperature of the atmosphere were higher than at present the rate of wave progress, for the free wave, would be less than now, and there might be a temperature at which the diurnal and semidiurnal oscillations would be much greater than at present.

When we study the geographical distribution of the barometric oscillations we find them varying with latitude and longitude, and especially with the continental or oceanic position of the stations. This is plausibly due to the fact that wave progress varies with temperature and pressure, but especially with the depth of the oscillating liquid. In this respect there may be much analogy between the motions of limited portions of the atmosphere and limited portions of the ocean. On a preceding page we publish a memoir by Mr. Rollin A. Harris, of the Tidal Division of the United States Coast and Geodetic Survey, in which he shows how local oscillations of restricted portions of the ocean, similar to the seiches of the Swiss lakes, can affect the general oceanic tidal wave and produce the actual tides that are of importance to navigators, while the principal tide in mid-ocean is comparatively small. The memoir of Mr. Harris is worthy of consideration by those engaged in studying periodic barometric oscillations.

SOLAR SPOTS AND TERRESTRIAL PHENOMENA.

According to an article by Dr. J. Halm, published in Nature March 8, 1900, it may be possible that the sun spots are an index to the existence of what may be called cosmic forces that have to do, not only with the magnetic storms and the aurora on the earth, but with minute disturbances in the annual motion of the earth around the sun. As is well known the solar spots had a minimum near the middle of the eighteenth century. Since that time the eleven-year periods have been well marked, but the intervals of minima and maxima have varied considerably; there was a high maximum in 1783, a low minimum in 1816, a high maximum in 1838, a moderate minimum in 1861, a small maximum, 1873, and a low minimum in 1888. By comparing the irregular changes in the obliquity of the earth's orbit with the curve of sun spots Dr. Halm finds three maxima and minima, viz, those of 1780, 1815, and 1840, and perhaps other smaller ones, clearly recognizable in both curves, and he states that after taking account of this new disturbing force, due to solar spot activity, the observed values of the mean obliquity are brought into entire agreement with the deductions of planetary theory based on Newton's law of gravitation. He adds that exactly the same peculiarities appear in the variations of all the other elements of the motion of the earth; they all show well-marked periodic fluctuations closely agreeing with those of the great spot period. This connection suggests to him that this solar force, which thus seems to modify the law of universal gravitation and the action of the sun upon the ellipsoidal excess of the earth's mass, may also affect the latitudes of places on the earth, that is to say, the position of the earth's axis within the earth. The recent investigations of Chandler into the variations of latitude when compared by Dr. Halm with the sun spot curve show that—

> The radius of the circle described by the pole of instantaneous rotation is greatest at times of sun spot minima and smallest at times of maxima. This correspondence holds true for the whole interval of sixty years now covered by Dr. Chandler's investigations * * * the latitude phenomena lagged behind the spot curve by about 1.5 years. * * * Sir Norman Lockyer discovered that a similar lag can be traced in the curves representing the changes in the lines widened in sun spot spectra during a spot cycle; the maxima and minima of the spectroscopic curves, so far as the observations go, show a perfect synchronism with those of the curve of latitude variation.

Dr. Halm says:

> We are, it seems to me, fairly warranted in assuming the force acting in such a peculiar way on the motion of the terrestrial pole to be

identical with that which exerts its influence on the secular variations. As regards the nature and origin of this force, there is a wide field for speculation.

The Editor is not yet prepared to recognize the force of the demonstrations that have been adduced by Dr. Halm. Coincidences between sun spot frequency and various other phenomena have been made the basis of innumerable memoirs and have led to a host of most suggestive hypotheses as to the connections that must, or at least may, exist between most diverse phenomena within the solar system. As we know nothing about the nature of the force of gravitation it is perfectly proper for us in our ignorance to acknowledge that it is a plausible hypothesis that gravitation may be affected by the same cause that produces the sun spots and may vary simultaneously with them. But in order to give this hypothesis a satisfactory basis, we need either better astronomical work or a profounder insight into the interaction of the physical ether and the ordinary molecules of matter. We need to know something more as to what sun spots are and what causes them or what is that physical connection between the sun and the earth by virtue of which we receive not only light and heat, but chemical and electrical influence. After many centuries philosophers discovered how the ocean tides are caused by the solar and lunar gravitation. Clerk Maxwell made the profound suggestion that electrical and magnetic phenomena might be traced back to the so-called viscous tides and strains within the earth's crust; recent electricians seem to have shown that the electrified condition of the upper air is due to the chemical action of the solar radiation. There is reason to expect further progress in this direction and it will be proper for us to publish in the next MONTHLY WEATHER REVIEW the views advocated by Prof. Ernest W. Brown as to the nature of the sun spots and the plausibility of further connections between the sun and the earth.

THE STORMS OF MARCH, 1888 AND 1900.

The newspapers of New England contain many comparisons between the blizzards of 1888 and 1900, the general conclusion being that the famous storm of the former year still holds its own as the severest of the century. The snowfall varied from 2 to 4 feet in depth during the first two days of the current March; the wind was severe; ordinary roads were entirely blocked, owing to the quantity of snow already on the ground; the railroad service was severely disorganized, but telegraph and telephone service was not affected to so great an extent. The Montpelier papers say:

> It takes something more than 3 feet of snow to stagger the managers of the Montpelier and Wells River Railroad, which is one of the hardest in the State to keep open." * * * "The great blizzard of 1888 began in Vermont on Monday morning, March 12, and it continued snowing heavily until Thursday night, while the wind piled it up into immense drifts. There was no communication, even by wire, with New York and Boston for two days and a half, and no trains or mails reached Burlington, Vt., between Monday morning and Wednesday evening.

The storm of March 1, 1900, throughout New England and New York was, in general, slightly inferior to that of 1888. In some cases, however, as in Rochester, the snowfall was decidedly the largest on record. The Rochester Democrat and Chronicle says:

> The longest drawn out snowstorm on record for this city was that of January, 1889, when it snowed from the 2d to the 4th of January, but only a small quantity of snow fell. The average snowfall for February is 17 inches; the greatest for one is 90 inches; and thus Rochester in two days got a third as much as the record for the season. But there was on the ground in 1893 29 inches of snow, some 2 or 3 inches more than there is now. During the winter of 1847-8 there was on the ground, it is said, 35 inches of snow about 100 miles southeast of Rochester. Buffalo at one time had 9 feet of snow—the fall for the month. This was in 1879. Arches were constructed of the snow, and people walked under them in the street.

Buffalo and Toledo report that the snowfall was not so heavy as in the storm of 1894, but that the drifts were worse than on that occasion.

At Portland, Me., the maximum easterly wind is said to have occurred about 10:30 to 11:30, March 1, at which time the water in the harbor had risen to a point unequaled in recent years. At this time also vivid flashes of lightning were observed. In general the storm of wind and high water on the coast of Maine was the severest for twenty-five years past. At St. John, N. B., it is called the severest since "the Saxby gale."

From Ohio westward the storm was, in general, the most severe that had been experienced during the past fifteen years.

FROST PROTECTION BY HOT WATER.

According to the Citrograph, published at Redlands, Cal., Mr. E. A. Meacham, of Riverside, has been experimenting on a method of protection against frost by the use of hot water. The plan is to heat water and spread it over the orchard in the usual way of irrigation. The water is heated in a large boiler under which is burning an oil jet. The water is distributed in furrows between the trees of the orchard to be protected. Water, which stood at a temperature of 60°, was heated in a short time to 94° F. The cooling of the water, after it had flowed in the furrows, was carefully measured; it was found to have a temperature of 58° at a distance of 20 rods from the boiler, and of 52° at 40 rods distance. While the heated water was flowing a decided amount of vapor rose from it and from the land that was wetted and warmed by it. Mr. Meacham's plant cost about $200, and the cost of operating it is about 60 cents per hour. The observations of temperature were made by Mr. A. G. McAdie, Forecast Official, who has made a full report on the matter which will be published in Weather Bureau Bulletin No. 29. The plant consisted of a 12-horsepower horizontal boiler and a secondary 6-horsepower boiler, which is used to generate the steam that is mixed with the burning oil so as to consume it entirely without smoke. The temperature of the air was about 34°, and the temperature of the unheated water in the open fields about 41°.

THE TOTAL ECLIPSE OF THE SUN MAY 28, 1900.

In the MONTHLY WEATHER REVIEW for September, 1899, will be found an article by Prof. F. H. Bigelow and a chart showing the path of totality as it passes from New Orleans, La., to Norfolk, Va. In addition to the many astronomers who will attend to observations that interest the astronomical world, there will, it is hoped, be some physicists and meteorologists who will look after the important matters that relate to the earth's atmosphere. Having been requested to state what observations are of special interest to meteorology, the Editor would suggest the following:

1. The solar corona consists of a bright interior portion which undoubtedly represents the sun's atmosphere and will be carefully studied by the astronomers. Outside of this are to be seen streamers of great delicacy and sometimes bright isolated spots. The general belief is that these relate to the space outside of the sun and not to the earth's atmosphere, but there is still a possibility that some of these may be due to the reflection of sunlight from particles of vapor or crystals of ice floating in the earth's atmosphere. Any observations that will elucidate the character of the outer corona will interest meteorology. The corona may be sketched by some as seen by the naked eye; by others it may be photographed